THE INFLUENCE OF CLIMATIC AND DIETARY FACTORS ON THE POPULATION DENSITY OF WILD BOAR *Sus scrofa* IN CATALONIA

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INTRODUCTION

The wild boar (*Sus scrofa* L., 1758) is considered to be one of the species with the greatest capacity for adaptation. Its wide geographical distribution includes, pre-desert regions, marshlands, mountain environments and forest. After its expansion across Europe, which began in the 1960s, the species has gradually occupied agro-ecosystems, with the populations exhibiting different levels of dependency on the food produced in agricultural areas. There are currently 17 areas in Catalonia that are participating in the monitoring programme for wild boar populations with the main aim of identifying the demographic trend of the different areas (Fig 1).

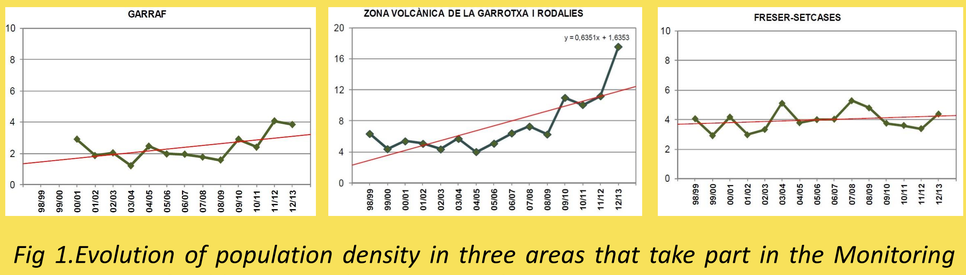


Fig 1.Evolution of population density in three areas that take part in the Monitoring Programme of Wild Boar Populations in Catalonia.

OBJECTIVES

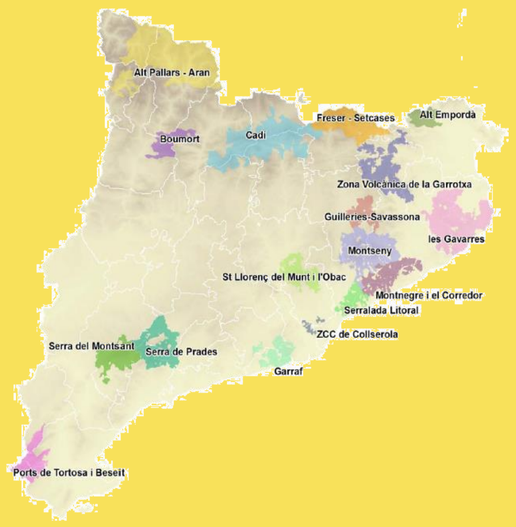
We know that climatic factors play an extremely important role in the dynamics of wild boar populations due to their impact on the availability of food and reproductive parameters (Fernández-Llario 2004). For this reason, the objective of this project focuses on identifying the climatic and dietary factors that play a key role in regulation of the regional variation in population densities of wild boar, and thereby contribute information that may help in the tasks of managing and controlling populations and know what can be the demographic trends of wild boar in different regions due to global warming.

METHODS

The statistic data has been conducted with a total of 7 variables (Table 1), where it has been studied the possible relationship of these on the density (dependent variable) from the data obtained in the monitoring program.

Table 1. VARIABLES

Food – According Map of Land use in Catalonia and IDESCAT (2009) respectively
% of the area covered by broadleaf trees (Holm oak, cork oak, oak, beech, chestnut and hazelnut)
% of the area dedicated to maize cultivation
Rainfall (mm) - According to the Digital Climate Atlas of Catalonia
Annual average
Spring average (April, May and June)
Temperature (ºC) - According to the Digital Climate Atlas of Catalonia
Annual average
Summer average (June, July and August)
Hunting – DAAM 2014
sessions/100ha
Demography
Density (individuals/100ha) – DAAM 2014



1- The effect of each of the variables on the density was analysed using a simple regression.
2- A multiple regression was also performed taking into account all al the seventeen areas (n=17 areas) and the seven variables of each of these areas in order to analyse the combined effect of these factors on density. In the case of the multiple regression, the stepwise, backward, forward, enter and remove methods were all applied.

A Kolmogorov Smirnov test was conducted to determine the normality of the dependent variable (density). A p value <0.05 was assumed with a tolerance of 0.02 when including variables in the multiple regression models. All of the statistical analyses were performed using the IBM SPSS Statistics programme (version 20) and the Microsoft Excel 2010 package. The GIS used for extracting climate statistics and surface area data related to broadleaf tree and maize crops were ArcGis and Miramón.

RESULTS

Simple regression

In the analysis of simple linear regressions, significant relations were identified with respect to density (*Fig 2.*) in the case of the proportion of area covered by broadleaf trees (p=0.000; r^2 de 0.819), summer temperature (p=0,016; r^2=0,327), and the proportion of the area covered by fields of maize (p=0.008; r^2=0.379). In terms of annual rainfall, no significant correlation was identified when all of the areas were integrated. However, when only the areas that have an annual water deficit greater than 60 mm were incorporated a clearly significant relation was demonstrated (p= 0.000; r^2=0.876, having excluded the Volcanic Region of La Garrotxa, Freser-Setcases, Boumort, Alt Pallars, Cadí and Ports de Tortosa). With respect to the rest of the variables integrated in the analysis, no significant correlations were obtained.

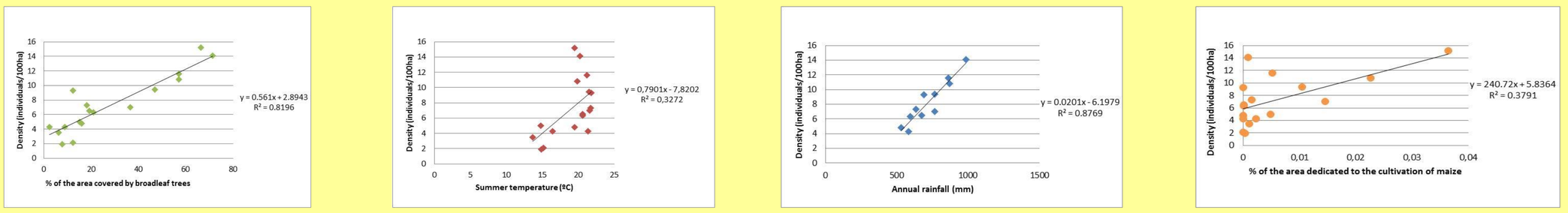


Fig 2. Graphs obtained through simple regressions. Density data comes from an average from the 2009-10 season to the 2013-14 season .

Multiple regression

The stepwise method only includes the variable related to the proportion of each area covered by broadleaf trees in its model (Table 2). In contrast, the backward method included three predictive variables, namely the summer temperature, annual rainfall and percentage of the land covered by broadleaf trees. This model improved the previous adjusted r^2 by 11.6% and reduced the estimated error by 13.3% in comparison with the stepwise model.

Sig.<0.05 (tolerance 0.02)	STEPWISE	BACKWARD		
r^2	0.732	0.835		
Adjusted r^2	0.714	0.797		
Variables included	%Broadleaf	Summer temperature	Annual rainfall	%Broadleaf
Significance	0.000	0,015	0.67	0.052
Standardized beta	0.856	0,616	0.436	0.433
Estimated error of the model	2.117	1.835		

Table 2. Result of the multiple regression with n=17 areas, describing the eight variables analysed with respect to population density in each of the spaces.

DISCUSSION

Several studies have demonstrated that favourable dietary conditions lead to the mating season starting earlier, as well as an increase in fertility and the size of the litter and reduce the age of the first reproduction. This study show that climatic factors have an important role on regulate population densities of wild boar in Catalonia. This may be due to the importance that climatic factors have in terms of the availability of the food eaten by wild boars. In case of rainfall, it facilitates access to underground food sources, as it softens the earth and enables wild boars dig more easily. About summer, it's known as a critical period where mortality of wild boar is related with high summer temperatures and scarce rainfall.

- Therefore, the results obtained in terms of summer temperature have to be interpreted as meaning that weather conditions involving a softer winter and richer vegetation promotes populations with higher densities.
- The results obtained of hunting intensity corroborates the opinion of other authors who state that impact of recreational hunting on wild boar densities is not sufficient to limit the dramatic growth in wild boar populations.
- In view of the scenario of climate change and based on the results obtained in this research, it is expected that, in the future, there will be an increase in wild boar densities in mountain zones due to climatic conditions that are more favourable to the development of this species (milder weather conditions and richer vegetation for feeding wild boars). In contrast, in more coastal areas, it is expected that the trend towards greater dryness will make obtaining underground food more difficult and, therefore, the population densities of wild boars will be affected negatively.

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